Measuring Broadband Australia

Report 10, September 2020

In 2017, the Australian Competition and Consumer Commission (ACCC) launched its project to measure internet performance. SamKnows was appointed to supply their Whiteboxes to internet users in Australia to measure the quality of experience for fixed-line internet.

The goal of Measuring Broadband Australia is to increase transparency and encourage greater performance-based competition and better internet performance throughout the country.

Overview

This is the tenth report issued as part of the Measuring Broadband Australia project. For this reporting period, measurements were collected over a 30 day period between 22nd May 2020 and 20th June 2020.

SamKnows prepares these reports each quarter for publication by the ACCC. The metrics are also presented by the ACCC in a public dashboard at:

https://www.accc.gov.au/consumers/internet-phone/broadband-performance-data
The program tests fixed-line services. It does not test fixed wireless or satellite services.
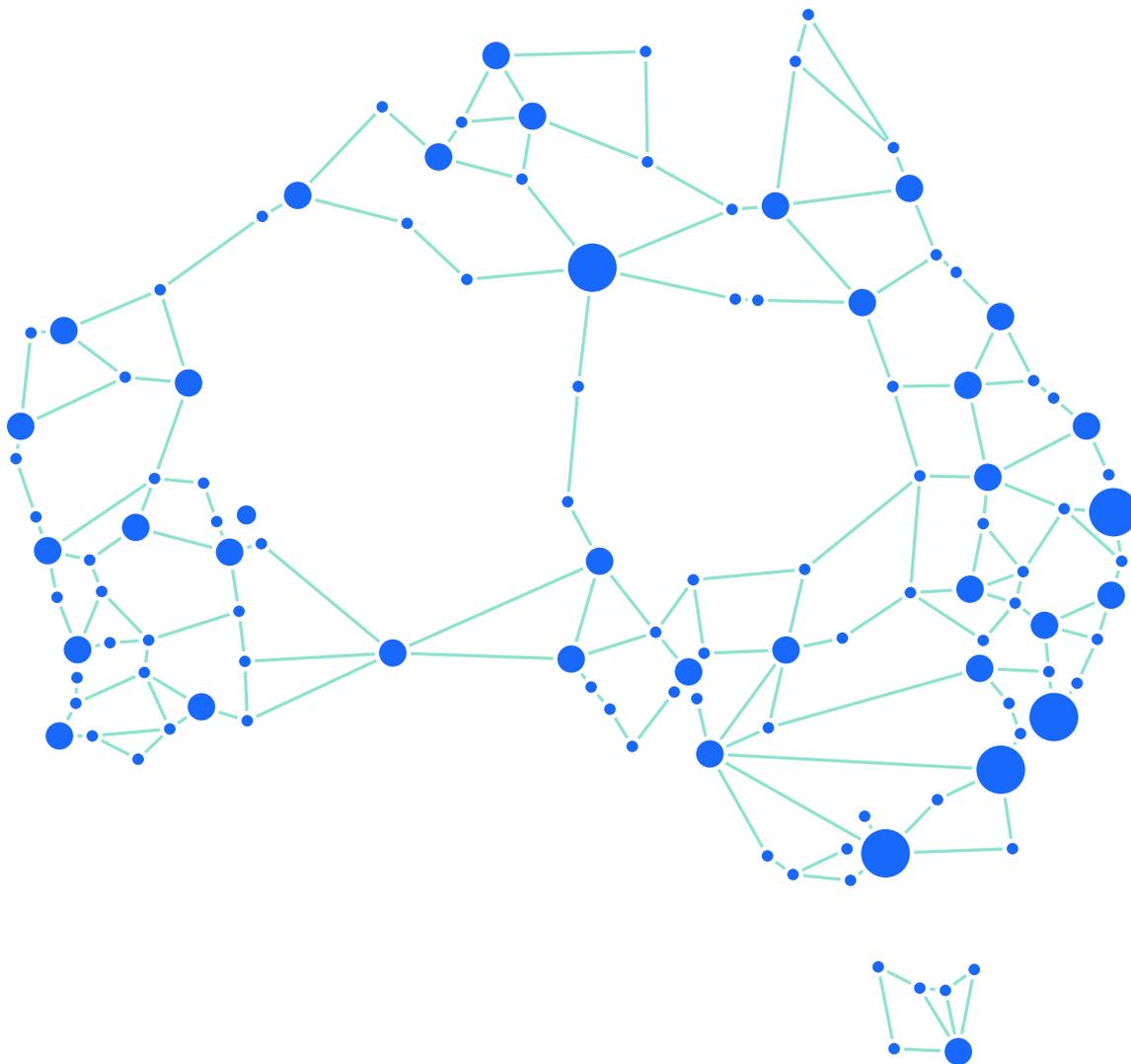
COVID-19 and NBN Performance

COVID-19 has led to a major switch in home internet usage patterns. More people are working and learning from home, increasing pressure on telecommunications networks. In response, NBN has provisioned more CVC (connectivity virtual circuit) capacity for RSPs, and data-heavy video streaming/conferencing applications have reduced picture quality. With these measures, NBN fixed line services have supported consumer and business needs during the COVID-19 pandemic.

We conduct our tests from our volunteers' homes to a test server that is hosted on a data network. That data network is co-located with other networks that host a broad range of popular online applications and content. This means that our test traffic and consumer broadband traffic follow common communications paths up until the point that they reach the data centres that host these data networks, but the last step on this path will often be unique to our test traffic.

If you were to imagine our test communications being transported in vehicles to a popular shopping centre, then they would travel on the same roads that consumers also use to reach that centre. Within the centre, our test traffic follows a particular path to the shop that provides speed test results, while consumer traffic will follow other paths to the many other shops that offer gaming, movies, information services and social and work collaboration spaces, etc.

We provision our test server so that in business-as-usual times it will always have more than enough capacity to carry our test traffic. This is to minimise the likelihood of that last step on the path causing low metrics, so that we can be confident that the results we report show the general performance of the broadband services that we are monitoring.

However, the unprecedented surge in internet traffic resulting from the COVID-19 pandemic has put significant pressure on all data networks, including the network that hosts our test server, so we have taken additional steps in preparing this report.

We closely analysed the results we obtained from our test servers, as well as from other online locations, and conducted checks with the operator of the data network that hosts our test servers. Specifically, we checked to ensure that any lower than expected test results were not caused by congestion that formed only at the test server, rather than by congestion on the network links to the data centre.

These checks have allowed us to select a test period for which we are confident that our test servers were generally operating normally. We have, however, still discarded results of some download and upload speed tests as we believe that the data network that hosts one of our test servers, located in Western Australia (WA), was likely congested during some of the evening busy hours that fell within the test period, so it would have skewed the metrics were we to include those speed tests results.

We also note that mitigation strategies have been put in place to address congestion issues for our test servers, such as infrastructure upgrades and purchasing of additional capacity.

We did not see any differences between latency tests from WA against those from other states, and so latency metrics for WA have been retained. Tests to third party applications, such as fetching webpages or streaming from Netflix, were also not affected and so results from WA for application performance metrics have also been retained.

Speed Test Results

Figures in this report relating to download and upload speed are generally expressed as a percentage of the maximum speed that can be achieved by the service plan. Hence, where the report outlines speed measures below 100 percent of maximum plan speeds, this should not be interpreted as the RSP having failed to provide the speed measures that it advertised.

Average download speed

ADSL & NBN plans - Including underperforming NBN services. Error bars indicate 95% confidence interval of the mean.
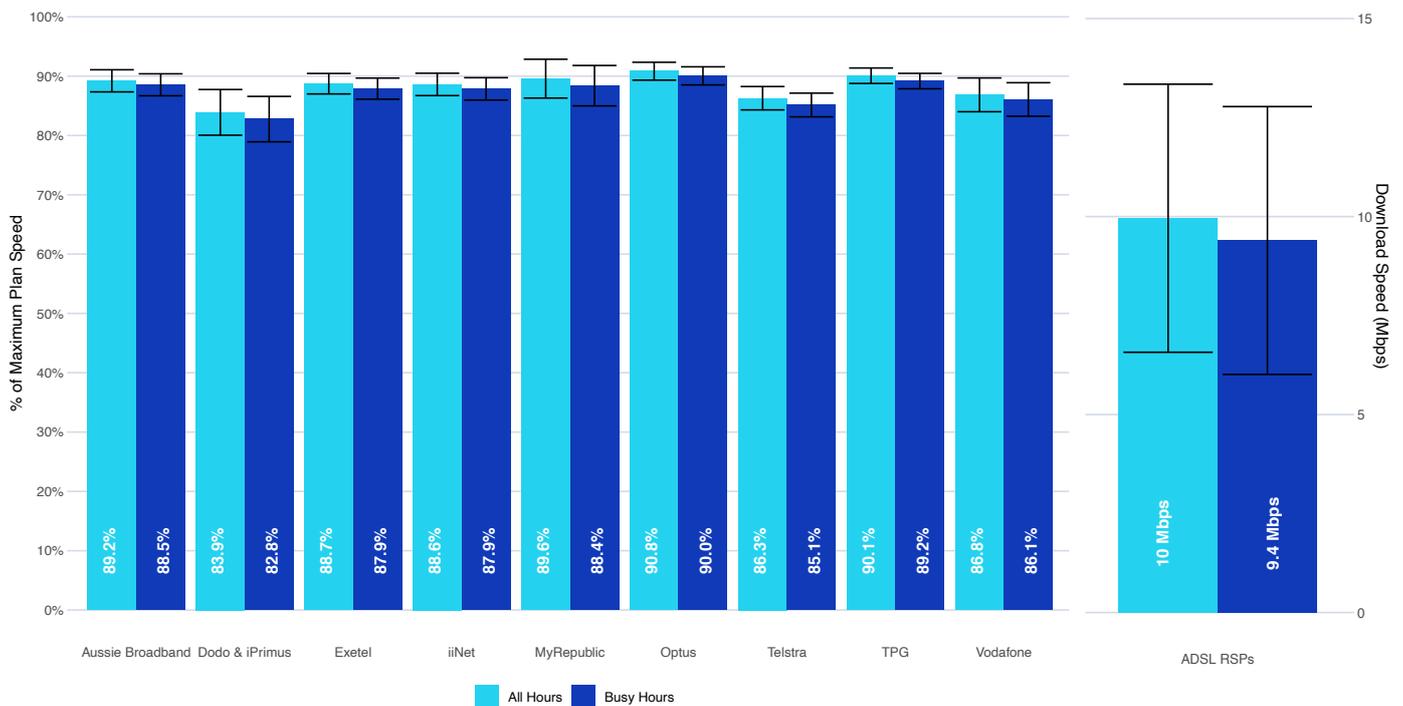
During this period, users on NBN connections received an average download performance of 88.5% of maximum plan speeds during all hours, decreasing to 87.6% during the busy hours (between 7pm and 11pm) which is when networks experience higher user activity.

These results are higher than those in the previous report, in which we reported download performance of 86.7% during all hours decreasing to 85.4% in busy hours. However, the results are not directly comparable since this report does not include speed test data from WA. If we had instead included the results for volunteers located in WA, busy hour download performance for each reported RSP would have been between 0.1 and 2.1 percentage points lower.

ADSL connections averaged speeds of 10.0Mbps, an increase on the 7.8Mbps observed in the previous report. As NBN rollout nears completion there are fewer Whiteboxes reporting on ADSL services - 16 in the current report. As such results for ADSL should be considered as indicative only.

As with previous reports, the 95% confidence intervals in the chart are a measure of how certain we are that the true average download speed lies between the upper and lower boundary indicated by the thin black lines. For example, Optus had an average download performance of 90.8% with a 95% confidence interval of ±1.5%. This means that if we were to repeat our sampling 100 times, we expect that average performance would fall between 89.3% and 92.3% in at least 95 cases.

## Average hourly download speed - ADSL & NBN plans

Including underperforming NBN services.
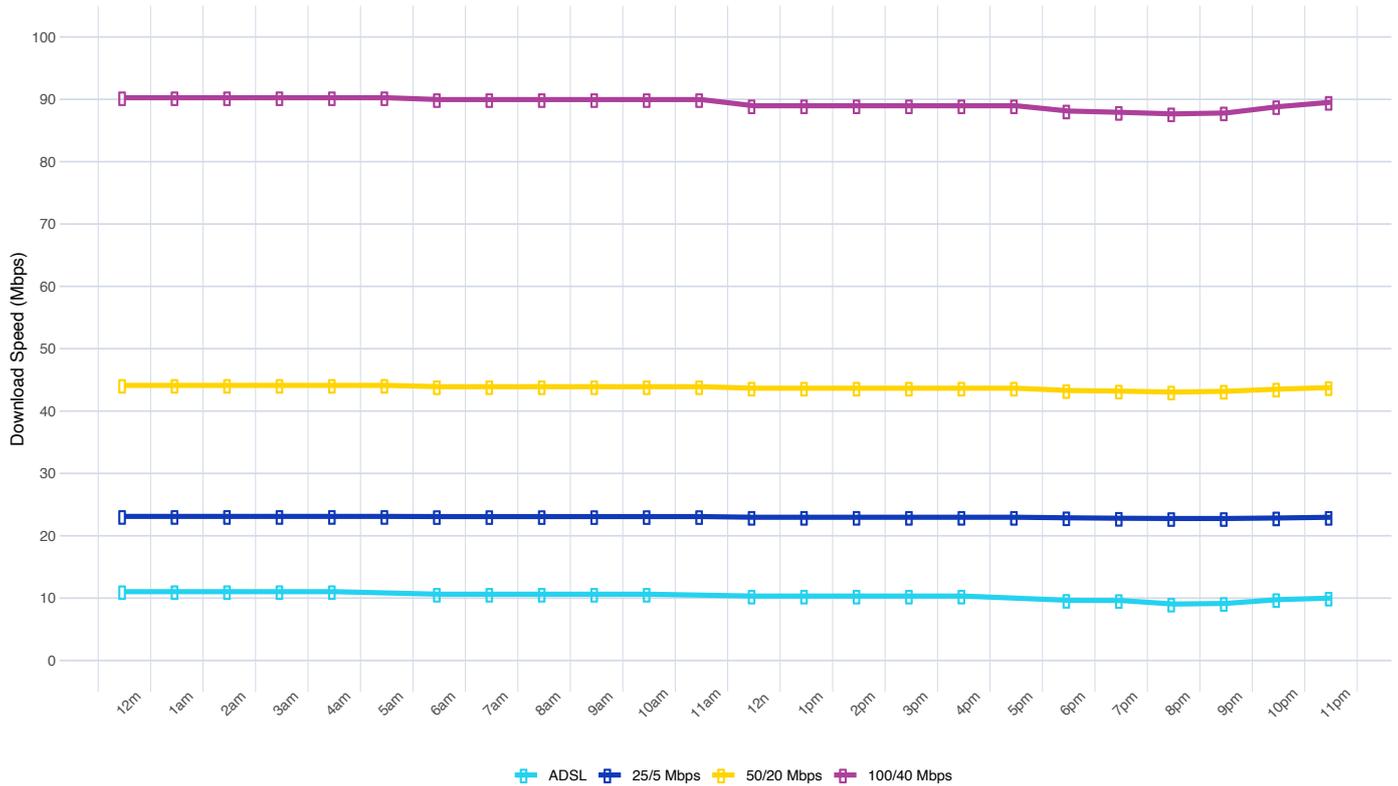
Average download speeds held steady throughout the day for users on most NBN speed tiers as well as for those on ADSL connections. The 100/40Mbps NBN tier remains the most affected by increased user activity in the evening hours: speeds typically started to decrease during the evening, dipping to 2.6Mbps below the day's maximum by 8pm, and then recovering to higher levels during the night.

Frequency of download speeds attained during tests - NBN plans

Including underperforming services.
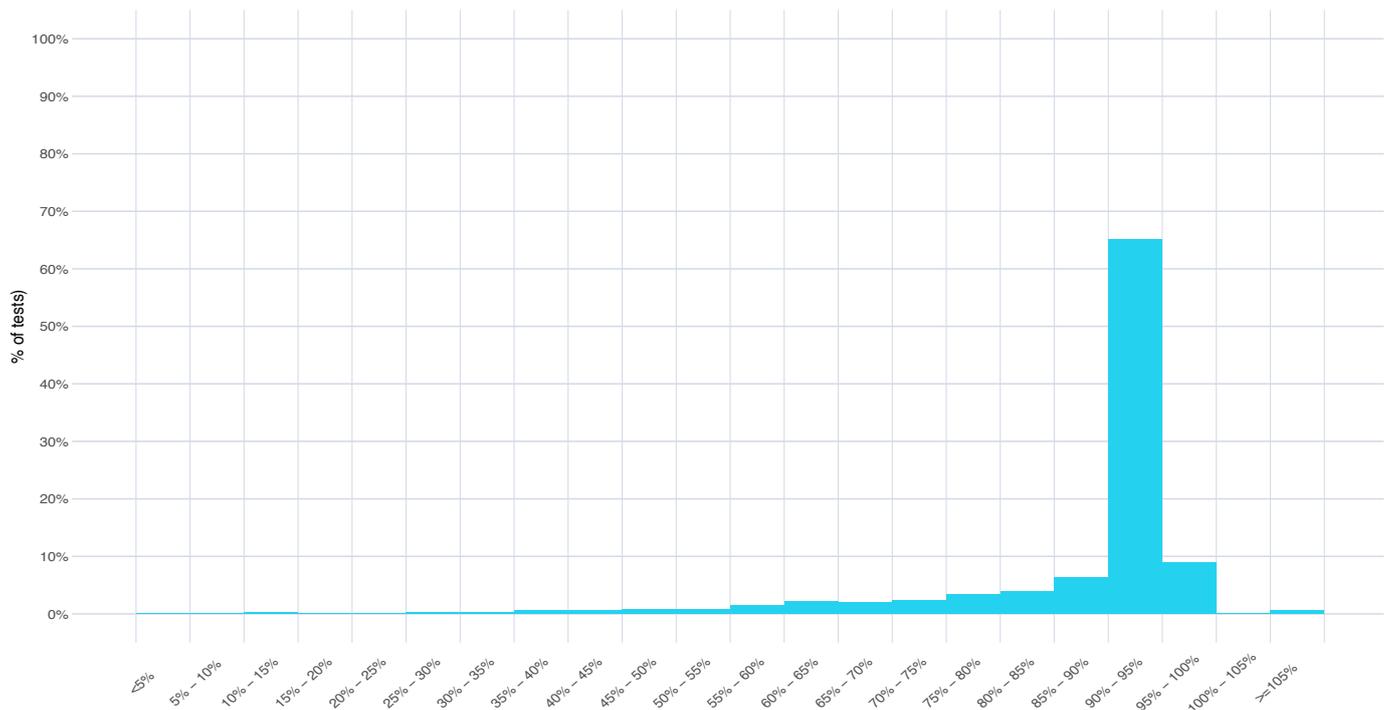
223,880 download speed tests were performed across 1,115 Whiteboxes connected to fixed-line NBN infrastructure during the period. 74.8% of tests conducted achieved a download speed of at least 90% of the maximum plan download speed – this is an increase from 69.6% in the previous report.

A small fraction of tests (around 0.8%) achieved speeds above 100% of 'maximum' plan speed. These can be attributed to a small number of services for which the RSP has provisioned a speed greater than the plan speed: for example an NBN100 service might be provisioned at 104 Mbps so that, after protocol overhead is taken into account, the service would still reliably attain speeds of 100 Mbps.

As we have noted in previous reports, a certain proportion of maximum plan speed is given over to protocol overhead, mainly consisting of packet headers. Although NBN Co has effectively over-provisioned its access services by a small amount, this has still meant that observed speeds (excluding those headers) have almost always been lower than the maximum plan speed.

As shown in the chart on page 5, a small fraction of tests (around 0.8%) have achieved speeds above 100% of 'maximum' plan speed. NBN Co has more recently increased its over-dimensioning of the downstream speed of its wholesale services to provide more capacity for protocol overhead. Consequently, we expect the proportion of services able to achieve the maximum plan speed reliably to increase as time goes on as NBN Co continues to expand the services it over-dimensions.

2.7% of tests achieved less than 50% of the maximum plan speed; for reference, in the previous report 5.9% of tests had failed to meet the 50% mark.
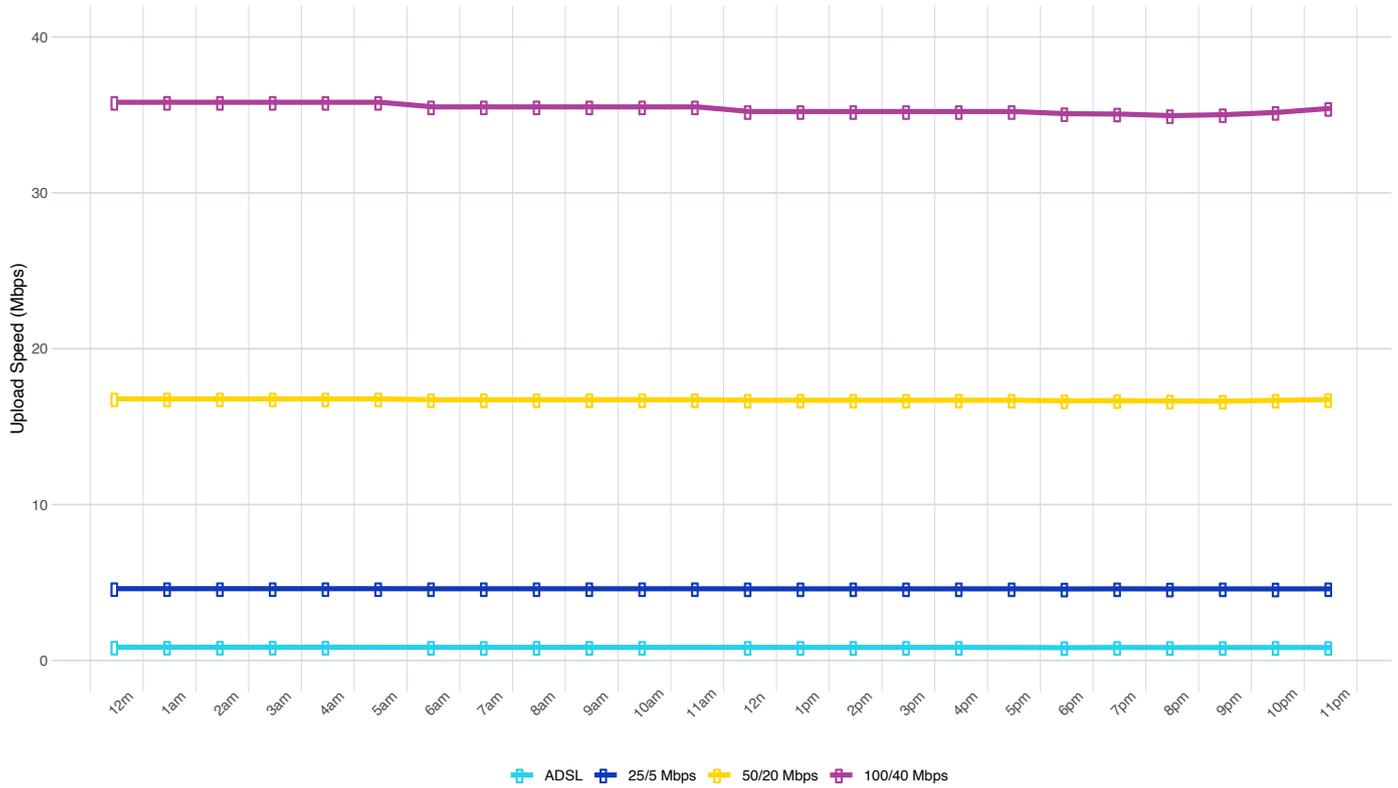
Average upload speed

ADSL & NBN plans - Including underperforming NBN services. Error bars indicate 95% confidence interval of the mean.
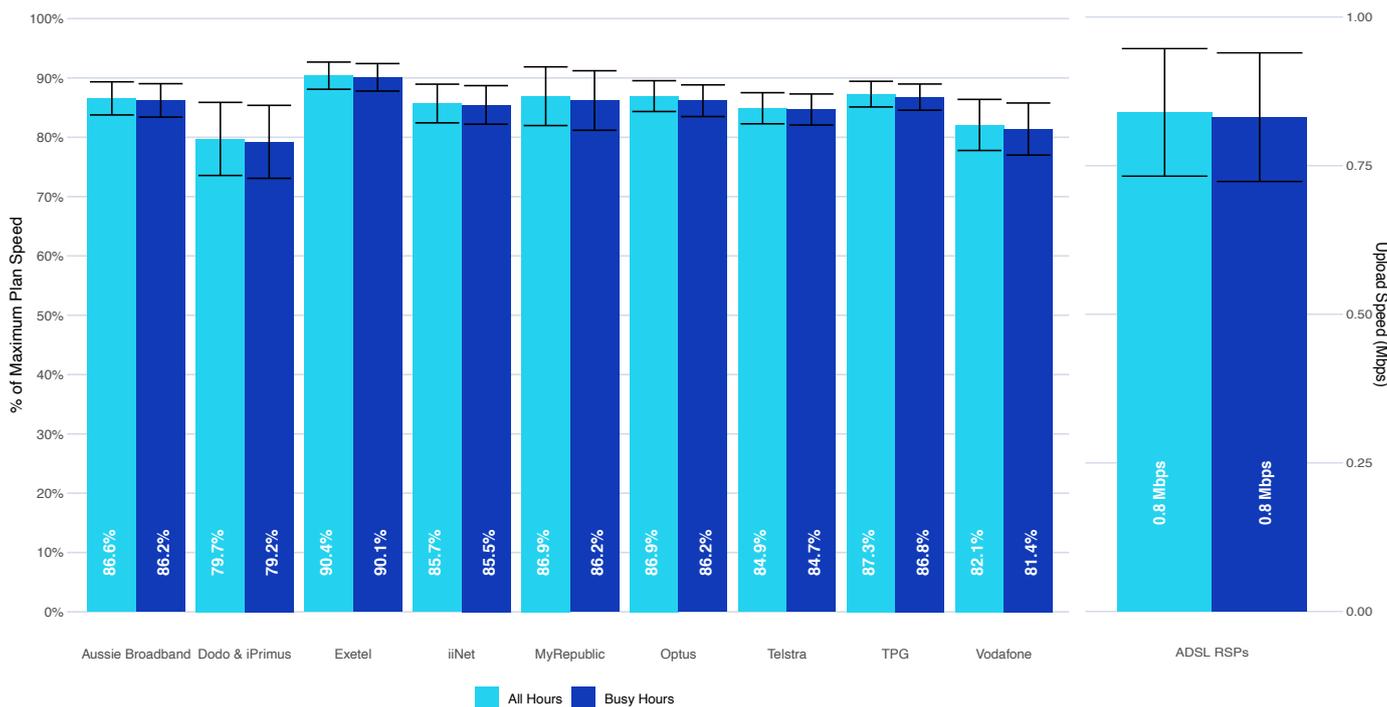
Upload performance was similar when compared to the previous report: NBN services achieved an overall average upload performance of 86.1% during all hours, as against 85.2% in the previous report. ADSL connections averaged upload speeds of 0.80Mbps during all hours as against 0.72Mbps in the previous report. The average upload performances compared across RSPs ranged between 79.7% and 90.4% during all hours.

Average hourly upload speeds - ADSL & NBN plans

Including underperforming NBN services.

Average hourly upload speeds were steady throughout the day, with negligible change during busy evening hours.

Video Streaming

The following chart shows the proportion of NBN services on the main NBN plans which would be able to reliably stream (without stopping and starting) a varying number of videos from Netflix simultaneously.

A High Definition video stream from Netflix would take up around 6 Mbps of bandwidth on average. An Ultra High Definition (4K) video stream would take up 15.6 Mbps on average. The actual bandwidth used will vary during video streaming: for example Netflix would use more bandwidth during a fast-paced action scene.

The Whitebox measures the total downstream bandwidth available from Netflix's servers, and so using multiples of 6 Mbps (for High Definition) and 15.6 Mbps (for Ultra High Definition) allows us to infer whether a service would be able to handle different numbers of streams. This assumes no other use of the connection at the time i.e. that Netflix is the only application running.

Netflix streaming by NBN plan - busy hours

Excluding underperforming & impaired services.
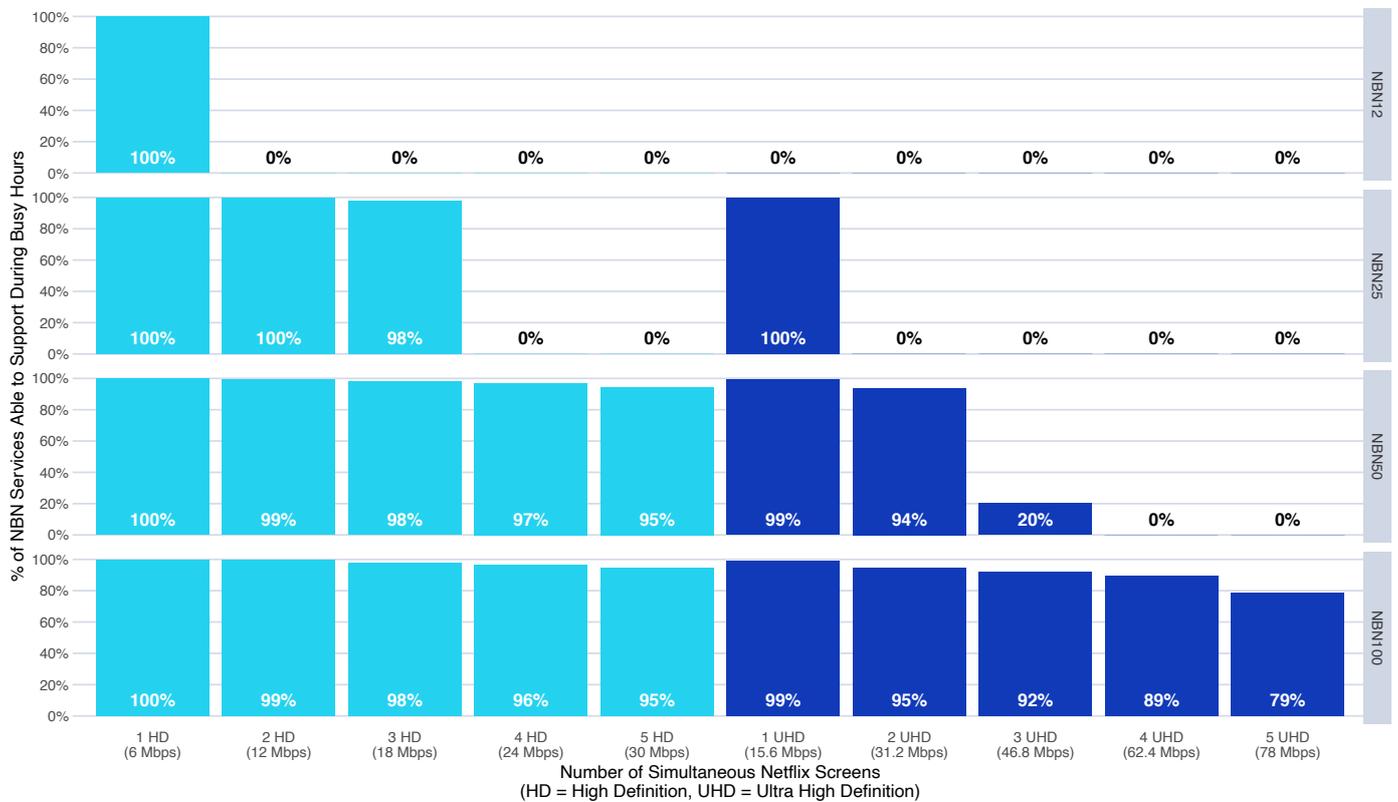
- NBN12 services would not be able to support more than one High Definition Netflix stream.

- Nearly all NBN25 services would support three simultaneous High Definitions streams, or a single Ultra High Definition video.

- NBN50 plans would be able to handle five High Definition or two Ultra High Definition videos.

- NBN100 plans will generally allow five Netflix videos to be watched with the highest quality settings available.

Similar tests were run to YouTube. Since YouTube throttles the bandwidth at which it serves video, test results could not be used to infer whether a service would be able to handle multiple concurrent streams. Nevertheless, effectively all tests from all NBN plans were able to stream YouTube reliably in High Definition.

There are enough Whiteboxes on the NBN50 plan to allow a comparison of Netflix performance by RSP. The following chart shows the proportion of NBN50 services which would be able to reliably stream two, three, or four simultaneous Netflix videos in High Definition, split by RSP.

Netflix streaming by RSP - NBN50 Services - Busy Hours

Excluding underperforming and impaired services.
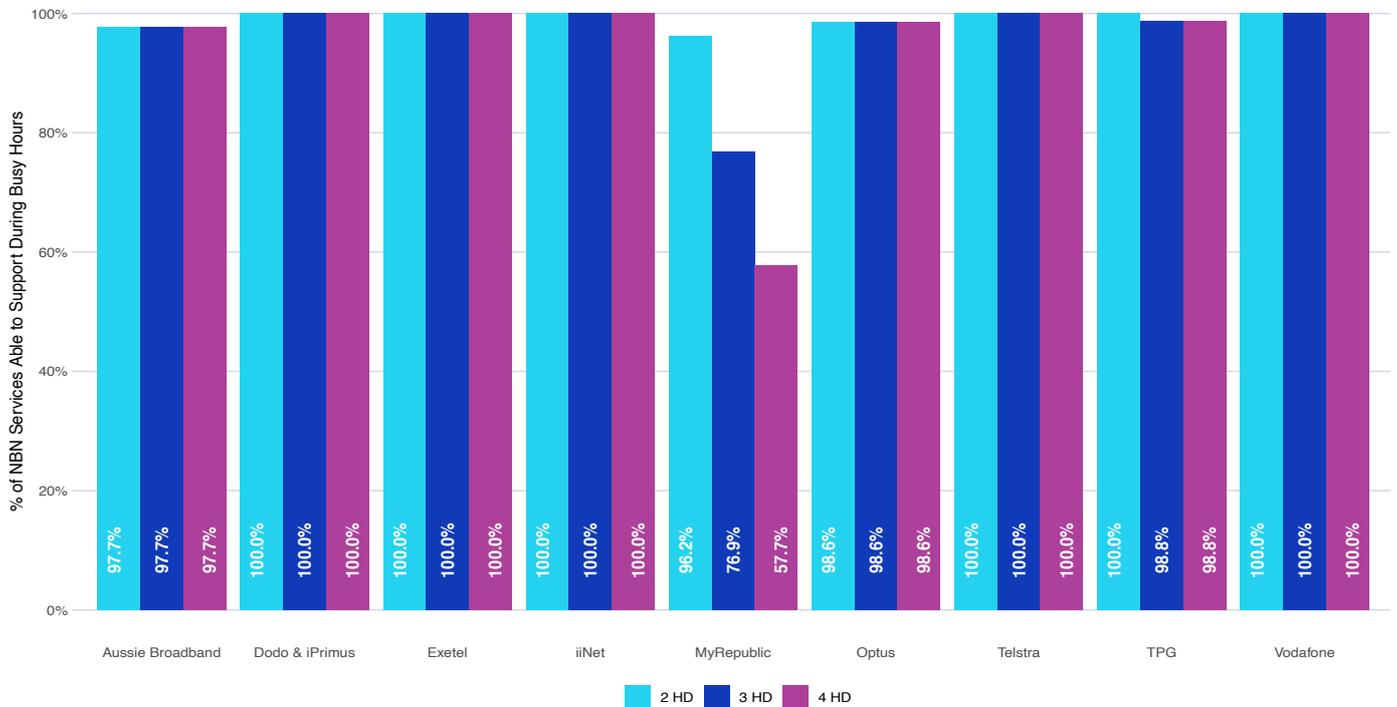
Compared against other RSPs, MyRepublic NBN50 services were less likely to support three or more simultaneous High Definition videos. It should be noted that the results for Dodo & iPrimus and MyRepublic are based on data from 23 and 27 Whiteboxes respectively, and so the results for those RSPs should be considered as indicative only.

Impact of underperforming services* on download speed

As in previous reports, we present separate measures of download performance exclusive of underperforming services. These are services that do not achieve speeds that approach the maximum plan speeds at any time of the day. These are essentially services that the RSP supplies to a consumer with a maximum plan speed that cannot be attained due to specific physical limitations affecting the service.

This information allows consumers to better understand the reported download and upload speed measures by removing the effect of services which, due to physical limitations, would be better assigned to another plan. At the same time, this comparison provides stronger incentives for service providers to improve service quality for customers on underperforming services; a small number of underperforming services can have an appreciable effect on an RSP's overall performance metrics.

Underperforming services** represented 8.1% of the 1,115 NBN services that were tested for this report. 97% of underperforming NBN services are fibre to the node connections. 99% are on NBN50 and NBN100 plans. The average download performance once underperforming services are excluded is 91.5% as against the 88.5% figure quoted earlier for all services. This means that if underperforming services had been remediated before the measurements were collected then overall download performance would have been 3.0 percentage points higher than was actually observed during the period.

As in previous reports, all RSPs' performance were impacted to some extent by underperforming services during the period.

Average NBN download speeds - all hours
Inclusive and exclusive of underperforming services. Error bars indicate 95% confidence interval of the mean.

	Aussie Broadband	Dodo & iPrimus	Exetel	iiNet	MyRepublic	Optus	Telstra	TPG	Vodafone
All NBN Fixed–line Connections	89.2%	83.9%	88.7%	88.6%	89.6%	90.8%	86.3%	90.1%	86.8%
Excluding Underperforming Services	91.4%	88.6%	90.0%	91.6%	92.5%	92.7%	91.1%	92.0%	90.2%
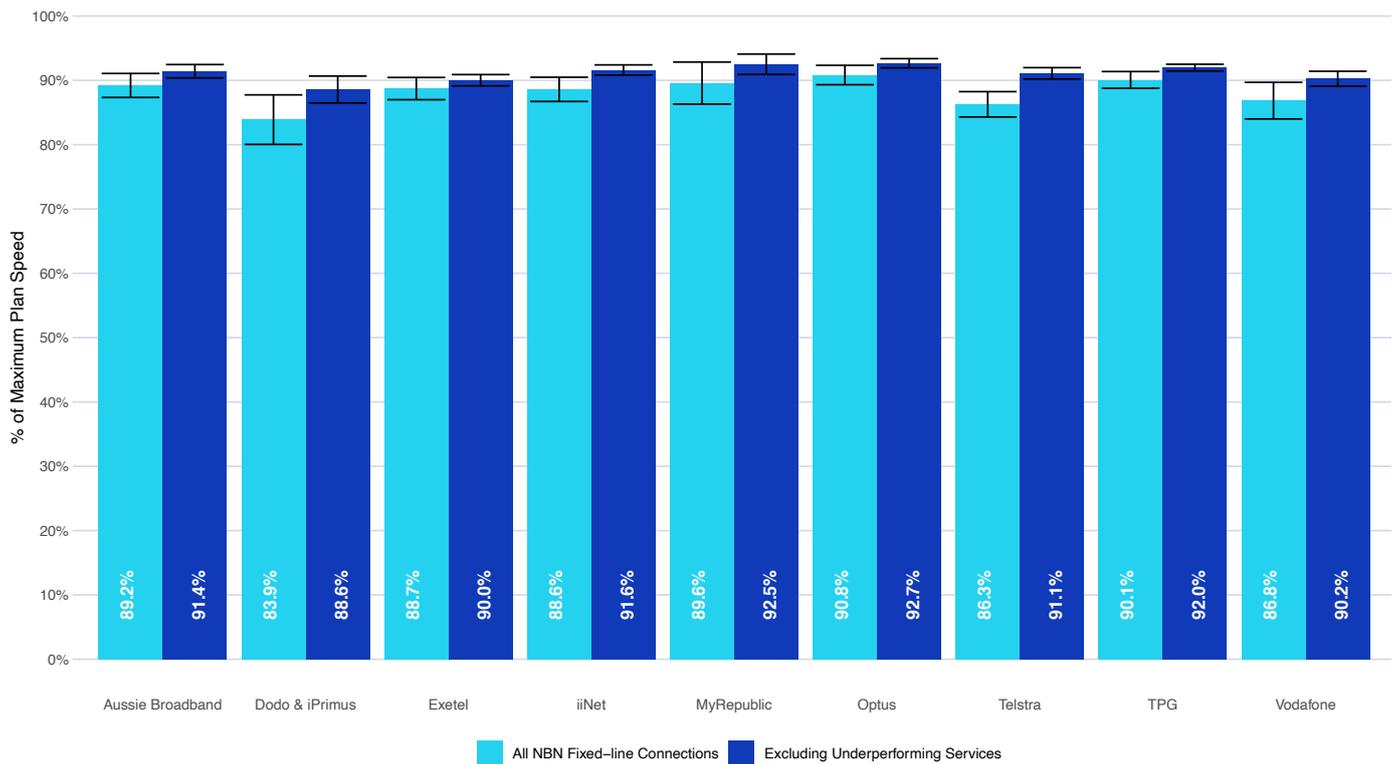
* We classify a service as 'underperforming' if no more than 5 percent of speed tests that we conducted over the service achieved a speed that was above 75 percent of maximum plan speed. This test effectively identifies those services with maximum attainable speeds that fall closer to the maximum speed of a lower speed tier than to the maximum speed of the consumer's current plan.
** Figure excludes WA.

Download speed by NBN Plan and Access Technology

The following chart shows average download speed for different access technologies[*] for different NBN tiers.

Average Download speed

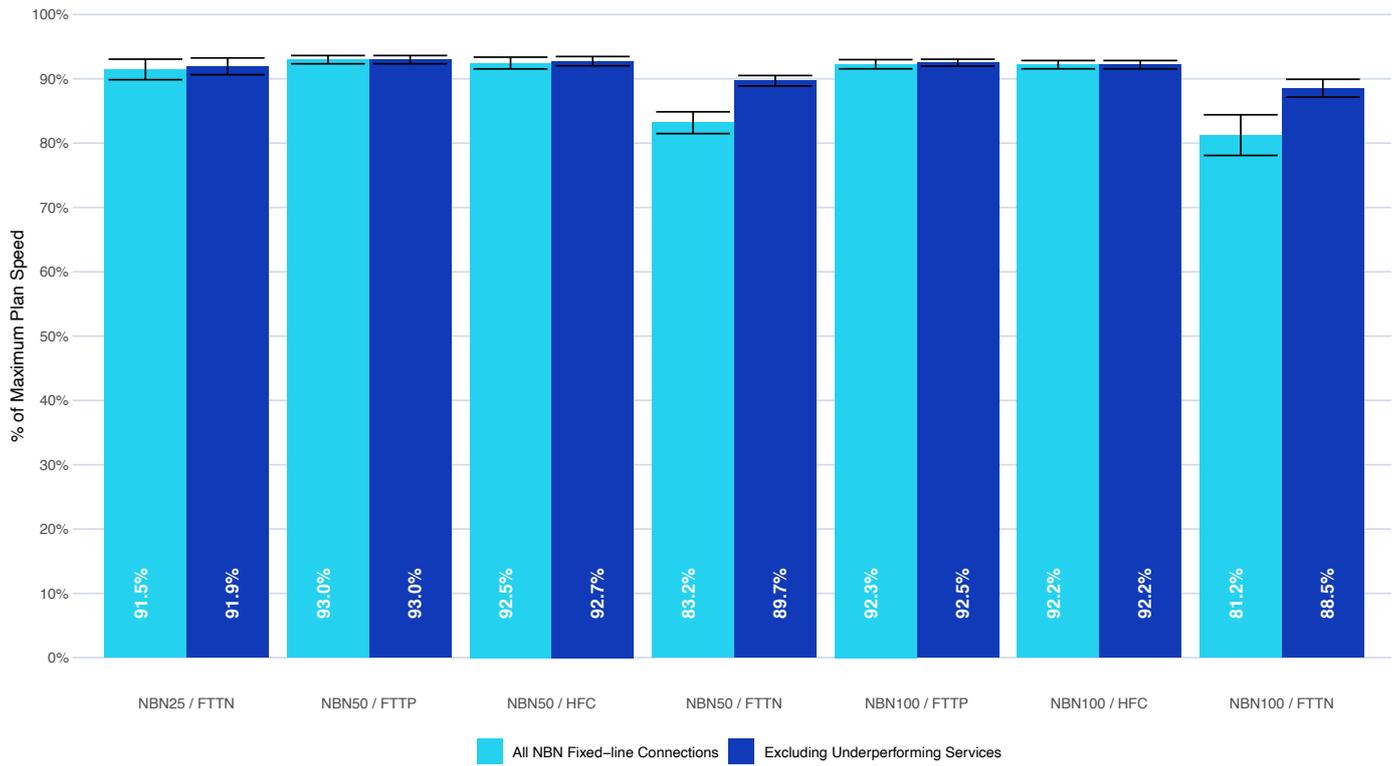*Inclusive of underperforming services . Error bars indicate 95% confidence interval of the mean.*
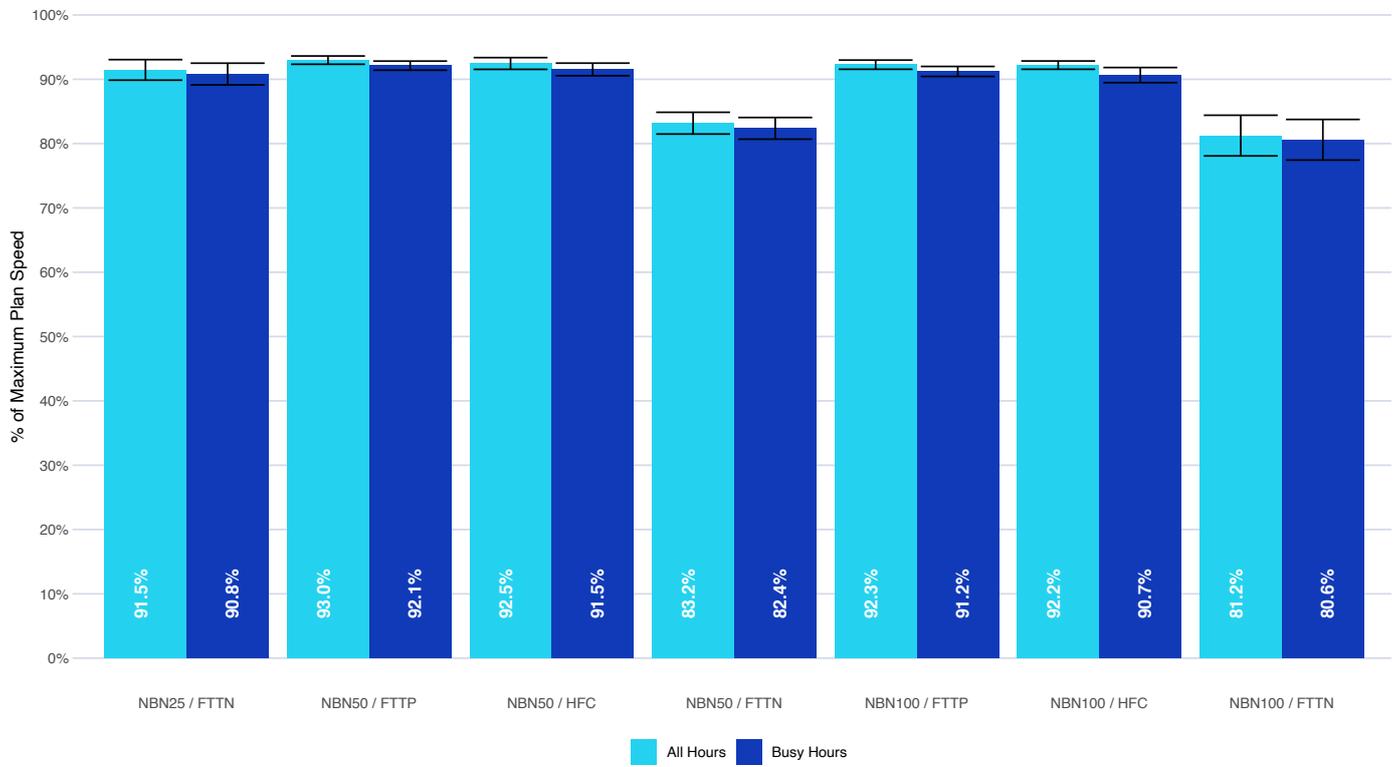
Within the 50/20 Mbps tier, fibre to the node services had an average download speed around 5 Mbps lower than other technologies. Within the 100/40 Mbps tier, fibre to the node services had an average download speed around 11 Mbps lower than other technologies.

The following chart shows the impact of underperforming services on the average download speed of different tiers.

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*   FTTC services are not represented due to insufficient sample size.

Average NBN download speed[*] - All hours

Inclusive & exclusive of underperforming services. Error bars indicate 95% confidence interval of the mean.

	All NBN Fixed–line Connections	Excluding Underperforming Services
NBN25 / FTTN	91.5%	91.9%
NBN50 / FTTP	93.0%	93.0%
NBN50 / HFC	92.5%	92.7%
NBN50 / FTTN	83.2%	89.7%
NBN100 / FTTP	92.3%	92.5%
NBN100 / HFC	92.2%	92.2%
NBN100 / FTTN	81.2%	88.5%

This demonstrates that fibre to the node accounts for the bulk of the impact from underperforming services for both the NBN50 and NBN100 tiers.

* FTTC services are not represented due to insufficient sample size.

Latency, Webpage Loading Time, and Packet loss by Plan

The following chart shows average round trip latency, which is the time required to send a packet of data to the test server and back. Lower latency will result in more responsive behaviour from real-time applications such as video conferencing and online gaming.

Average latency - ADSL & NBN plans

Including underperforming NBN services. Error bars indicate 95% confidence interval of the mean.
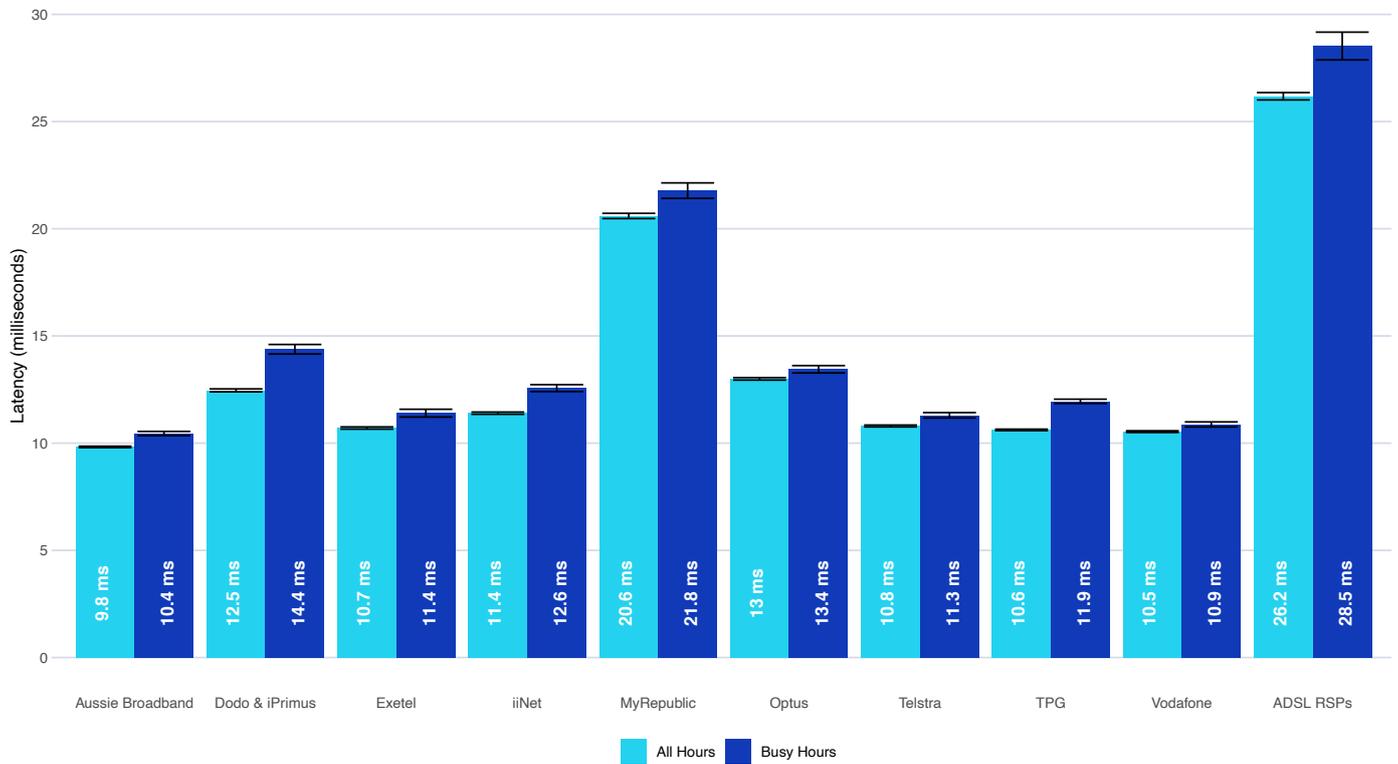
Average latency results from this period are in line with the previous report: average latency was generally below 13ms during all hours across RSPs with the exception of MyRepublic.

Connections served by MyRepublic had higher average latency than connections served by other RSPs, although average latency did remain at around the same level during busy hours. It should be noted that latency at even 30ms would have a detrimental effect on only the most latency-sensitive applications.

The following chart shows the average time required to fully load the most popular webpages for Australian users across all NBN speed tiers, per RSP.

Average webpage loading time - ADSL & NBN plans

Including underperforming NBN services. Error bars indicate 95% confidence interval of the mean.
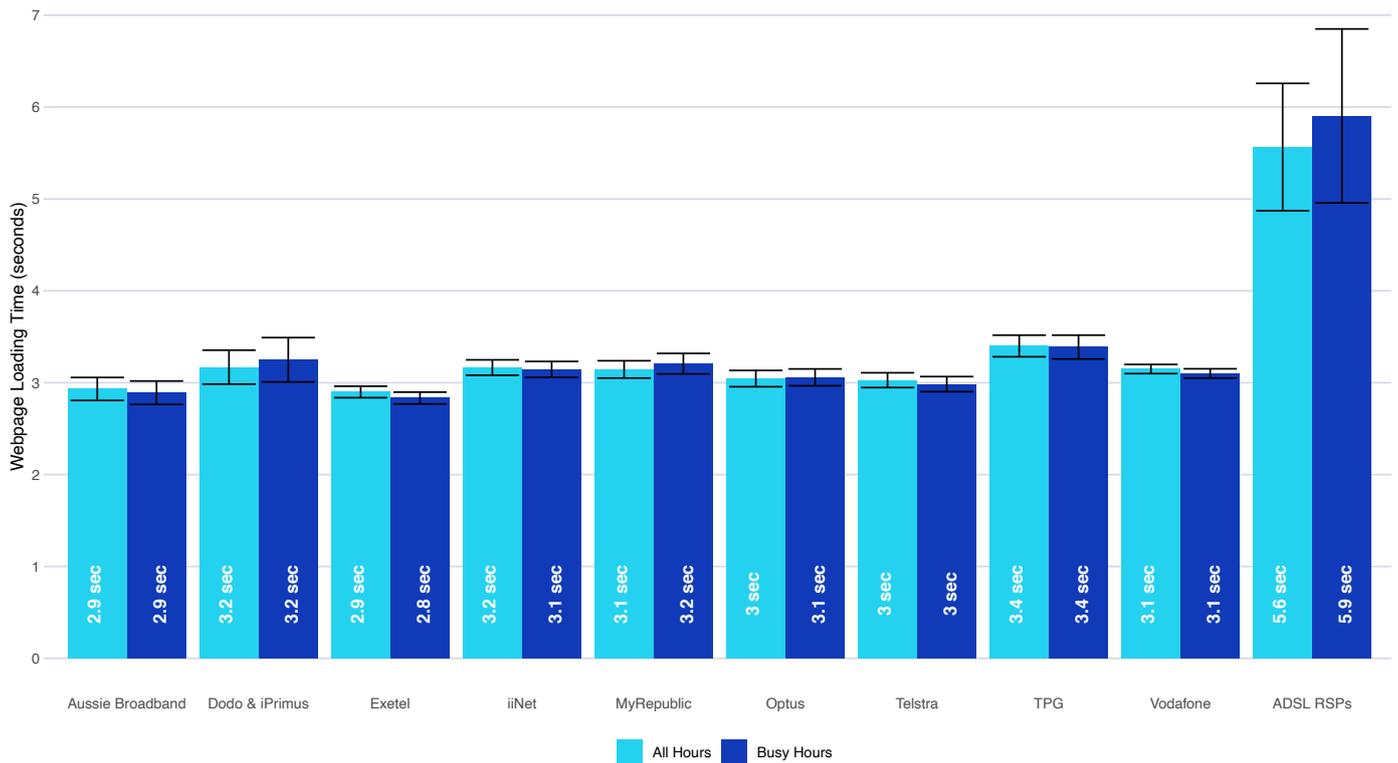
All RSPs were able to serve a webpage in around 3 seconds on average, and the average time required to serve a webpage did not increase materially during busy hours for any RSP.

The following chart shows the frequency at which different levels of packet loss occurred during tests.

Frequency of packet loss rates observed during tests - NBN plans

Including underperforming services
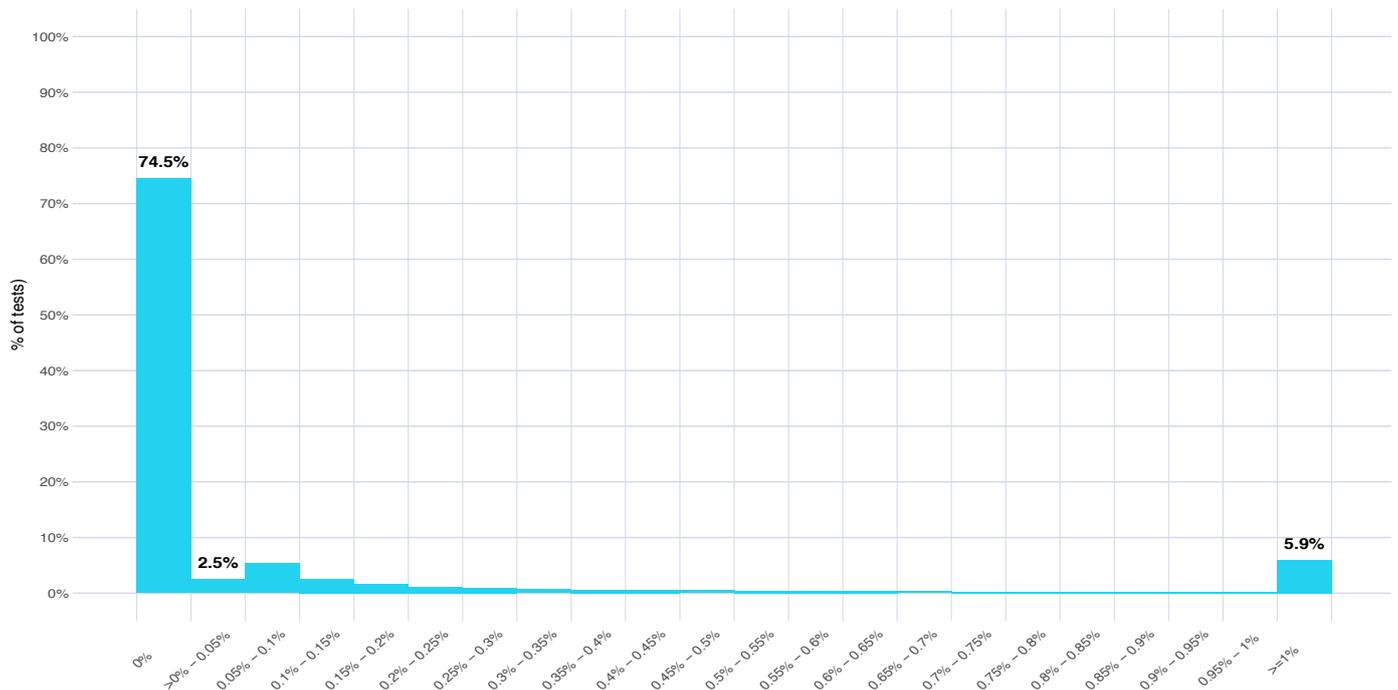
Packet loss is collected at the same time as latency measurements, the test counts the percentage of packets that do not make it to their destination. A total of nearly 813,914 packet loss tests were conducted over the measurement period. 77.0% of these tests had packet loss of either zero or less than 0.05%. For reference, in the previous report 76% of tests had packet loss below 0.05%.

At the other end of the scale, 5.9% of tests had packet loss greater than 1% as against 3.8% in the previous report. At levels above 1%, packet loss can cause issues which are detrimental to user experience, such as webpages failing to load.

Outages

The following charts show, for each RSP:

- The average rate of daily outages for a service, indicating how often outages occurred

- The distribution of outage duration, indicating the severity of outages' impact on user experience.

Average daily outages lasting over 30 seconds - all hours - NBN plans
Including unerperforming services.
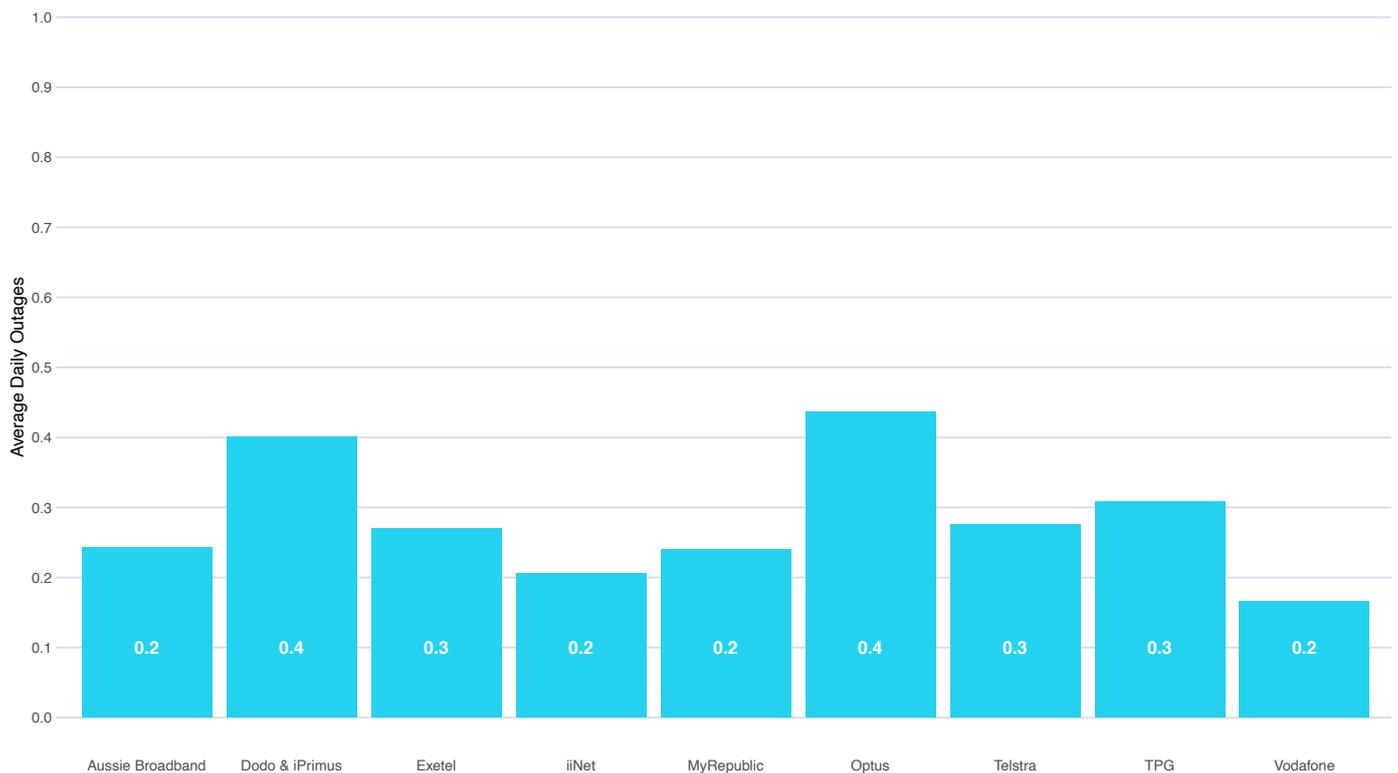
Distribution of outage duration by RSP - NBN plans - all hours

Including underperforming services.
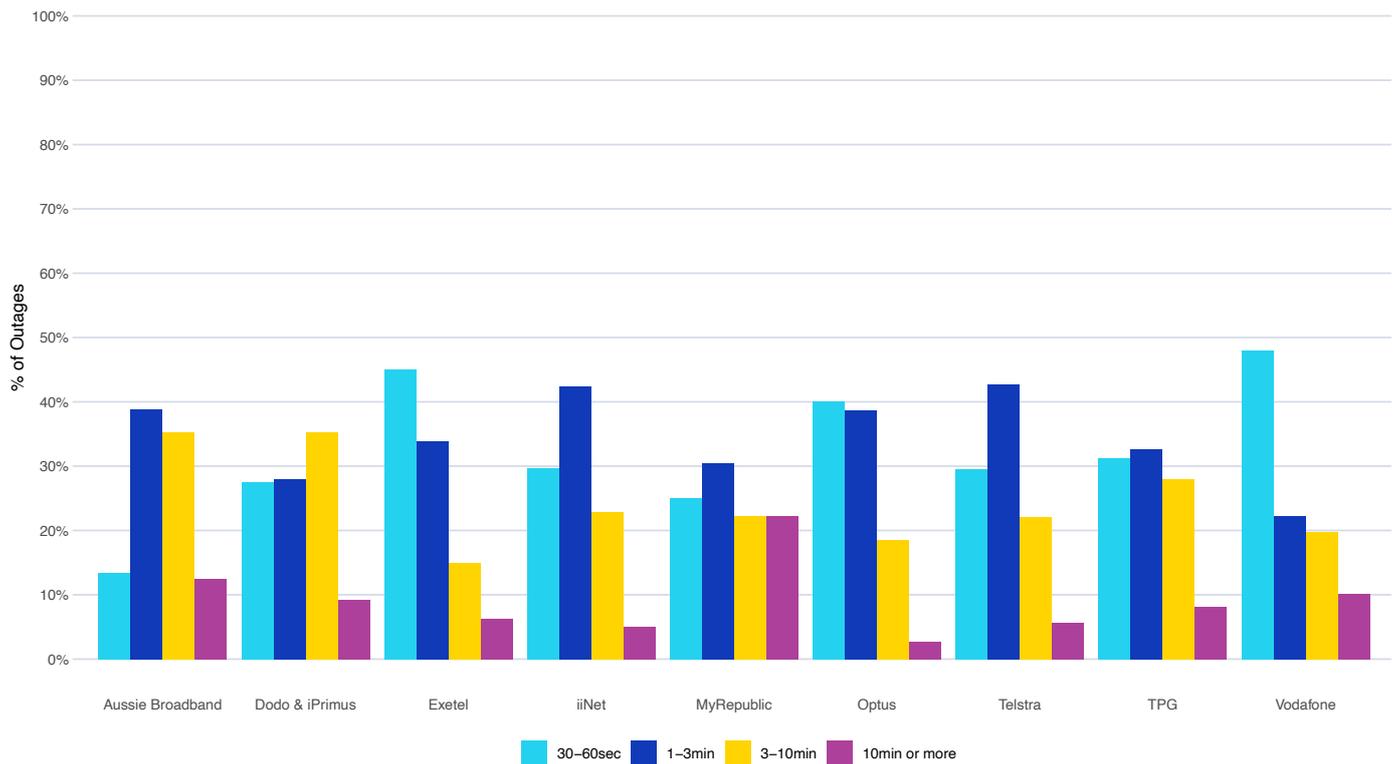
Vocus (Dodo & iPrimus) and Optus services had the highest rates of daily outages, the equivalent of two outages every five days on average. For both, however, it was relatively unlikely that an outage would last for longer than 10 minutes. MyRepublic services were the most likely to experience an outage longer than 10 minutes, although were no more likely to experience an outage than other RSPs' services.

Download speed during the busiest hour

In this report, the busiest hour speed is the fifth-lowest average hourly download speed across each busy hour within the month. The measurement period had a total of 30 days with 4 busy hours each, totalling 120 busy hours in the month. For each busy hour, we calculate the average download performance (download speed as a percentage of maximum plan speed) for each RSP. We take each RSP's fifth-lowest hourly download performance as an indicator of performance during the busiest hours when networks are under the highest levels of stress.

The chart below considers NBN50 and NBN100 plans and has three columns for each RSP:

- The first is a weighted average of the typical busy hour speeds advertised for these plans by each RSP at the end of the measurement period, expressed as a percentage of the maximum speed achievable by the plan. The weights used are the numbers of Whiteboxes online on the NBN50/NBN100 plans. See the 'NBN50 and NBN100 Advertised Speed Tables' section further in the report for full detail.

- The second column shows download performance during busy hours, expressed as a percentage of maximum plan speed.

- The third column shows download performance during the busiest hour (i.e. the fifth-lowest hourly average as explained above), expressed as a percentage of maximum plan speed.

A result in which the busiest hour speed is relatively close to average busy hour speed indicates that the plan is relatively unaffected by higher demand at especially busy times. Results in which busiest hour speeds are further below average busy hour speeds indicate that the plan is more affected by particularly high demand peaks.

At the end of the measurement period, RSPs advertised download speeds for their NBN50 and NBN100 products that were between 79% and 89% of the maximum achievable by the products, with Exetel advertising the lowest speeds, and iiNet the highest. Any services which are underperforming (as defined above), or which have an acknowledged impairment which prevents maximum plan speed from being delivered, have been excluded.

Advertised speeds and average download speeds - 50/20Mbps & 100/40Mbps plans

Exclusive of underperforming and impaired services.
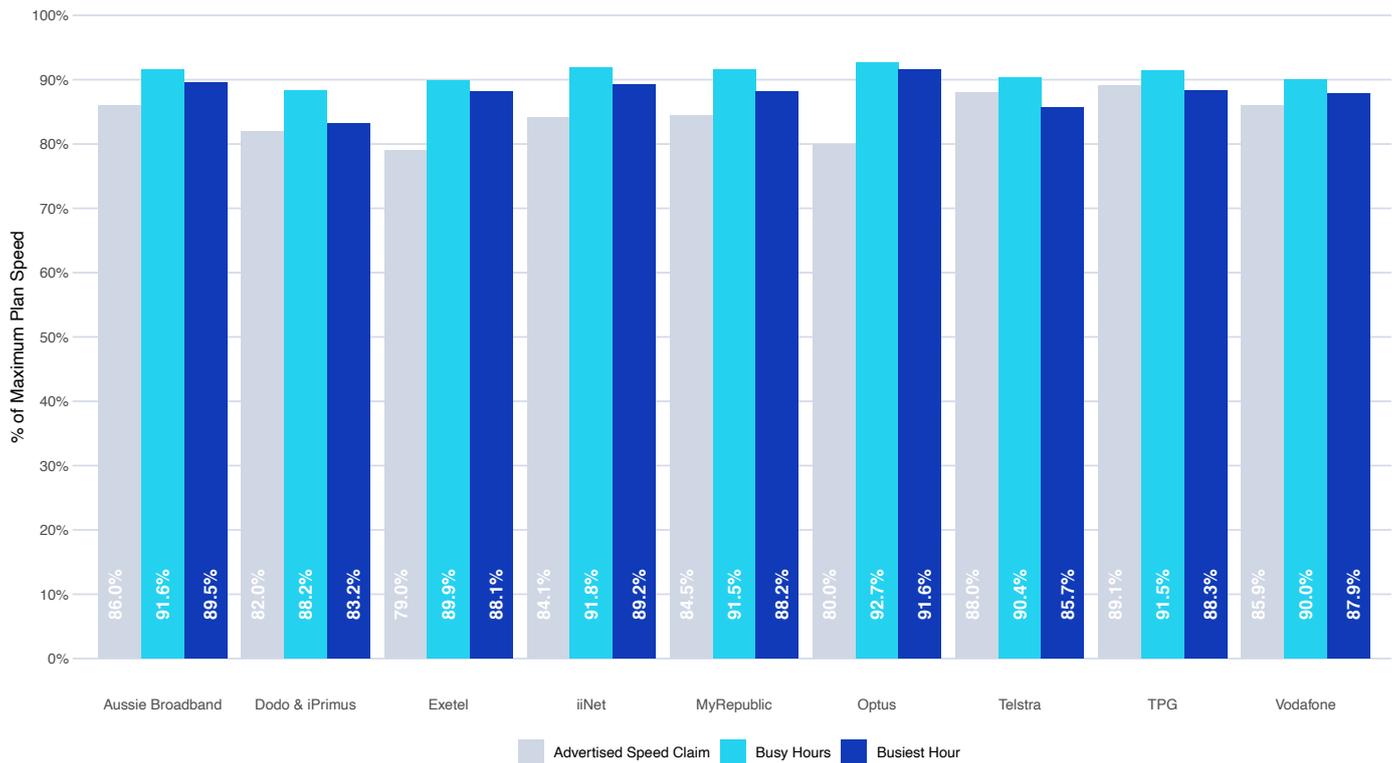
From these results we can see that if all underperforming services and impaired services had been remediated – or limited to supporting more appropriate plans - then all RSPs would have average speeds that exceeded advertised speed claims during the busy hours, and seven would have exceeded advertised speed claims during the busiest hour.

The chart below shows the percentage of busy hours during the period in which test speeds for NBN 50/20Mbps and NBN 100/40Mbps products met or exceeded the speeds advertised by RSPs.

Proportion of busy hours where advertised speed was achieved - 50/20Mbps & 100/40Mbps plans
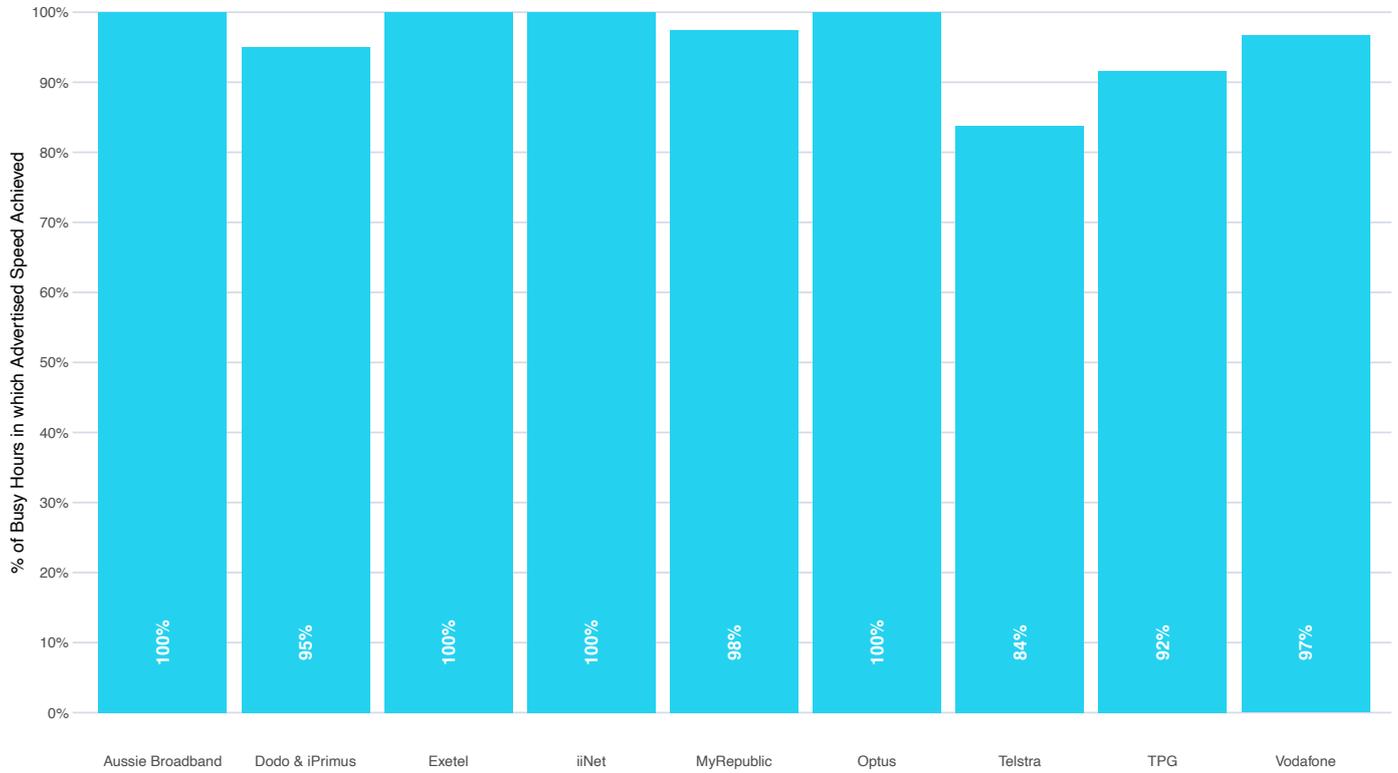
Exclusive of underperforming & impaired services.

If all underperforming services and impaired services had been remediated – or limited to supporting more appropriate plans - then the proportion of busy hours when RSPs met their advertised speed claims would have been no lower than 84% for any tested provider.

NBN RSP tables

The following tables show statistical information on download speeds, upload speeds, and outages for each RSP across all speed tiers, and for individual speed tiers in instances where at least 40 Whiteboxes reported successfully during the test period.

The overall speed is the average speed (download or upload) for the RSP, measured as a percentage of maximum plan speed.

Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.

The 95% confidence interval is a range in which the 'true' average value is estimated to lie and is a function of the sample size (i.e. number of Whiteboxes online) and standard deviation.

- If the standard deviation is larger then the confidence interval will be wider, reflecting greater variability in the underlying data. If the sample size is larger then the confidence interval will be narrower, reflecting more certainty in the underlying data.

- For example: during testing, we measured an average download performance of 88.7% of maximum plan speed for Exetel across all NBN tiers with a 95% confidence interval of ±1.7%. If we were to repeat our sampling 100 times, we expect that this average would fall between 87.0% and 90.4% in at least 95 cases.

Period	RSP	Download Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	89.2%	11.5%	87.3% - 91.1%	145	27,499
All Hours	Dodo & iPrimus	83.9%	14.2%	80.0% - 87.7%	52	10,139
All Hours	Exetel	88.7%	7.7%	87.0% - 90.4%	77	15,345
All Hours	iiNet	88.6%	11.2%	86.7% - 90.5%	137	27,742
All Hours	MyRepublic	89.6%	12.7%	86.3% - 92.8%	58	10,839
All Hours	Optus	90.8%	8.9%	89.3% - 92.3%	134	27,455
All Hours	Telstra	86.3%	14.5%	84.3% - 88.2%	209	44,604
All Hours	TPG	90.1%	9.1%	88.8% - 91.4%	188	37,306
All Hours	Vodafone	86.8%	13.0%	84.0% - 89.7%	80	14,849

Period	RSP	Download Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Aussie Broadband	88.5%	11.4%	86.7% - 90.4%	145	8,082
Busy Hours	Dodo & iPrimus	82.8%	14.1%	78.9% - 86.6%	52	3,004
Busy Hours	Exetel	87.9%	8.0%	86.1% - 89.7%	77	4,501
Busy Hours	iiNet	87.9%	11.2%	86.0% - 89.7%	137	8,306
Busy Hours	MyRepublic	88.4%	13.1%	85.0% - 91.8%	57	3,176
Busy Hours	Optus	90.0%	9.0%	88.5% - 91.6%	134	8,039
Busy Hours	Telstra	85.1%	14.7%	83.1% - 87.1%	209	13,156
Busy Hours	TPG	89.2%	9.1%	87.9% - 90.5%	188	10,908
Busy Hours	Vodafone	86.1%	12.9%	83.2% - 88.9%	80	4,397

Period	RSP	Upload Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	86.6%	17.2%	83.8% - 89.3%	145	27,437
All Hours	Dodo & iPrimus	79.7%	22.7%	73.6% - 85.9%	52	10,014
All Hours	Exetel	90.4%	10.3%	88.1% - 92.7%	77	15,307
All Hours	iiNet	85.7%	19.5%	82.4% - 89.0%	137	27,611
All Hours	MyRepublic	86.9%	19.2%	82.0% - 91.9%	58	10,814
All Hours	Optus	86.9%	15.3%	84.3% - 89.5%	134	27,324
All Hours	Telstra	84.9%	19.3%	82.3% - 87.5%	209	44,403
All Hours	TPG	87.3%	15.1%	85.1% - 89.4%	188	37,051
All Hours	Vodafone	82.1%	19.7%	77.8% - 86.4%	80	14,796

Period	RSP	Upload Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Aussie Broadband	86.2%	17.3%	83.4% - 89.0%	145	8,062
Busy Hours	Dodo & iPrimus	79.2%	22.6%	73.1% - 85.4%	52	2,918
Busy Hours	Exetel	90.1%	10.4%	87.8% - 92.4%	77	4,513
Busy Hours	iiNet	85.5%	19.4%	82.2% - 88.7%	137	8,217
Busy Hours	MyRepublic	86.2%	19.3%	81.2% - 91.2%	57	3,151
Busy Hours	Optus	86.2%	15.8%	83.5% - 88.8%	134	7,994
Busy Hours	Telstra	84.7%	19.3%	82.1% - 87.3%	209	13,109
Busy Hours	TPG	86.8%	15.4%	84.6% - 89.0%	188	10,828
Busy Hours	Vodafone	81.4%	20.0%	77.0% - 85.8%	80	4,376

Period	RSP	Speed Tier	Download Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	100/40 Mbps	89.9%	10.5%	87.4% - 92.4%	66	11,863
All Hours	Aussie Broadband	50/20 Mbps	86.8%	13.3%	83.3% - 90.3%	56	11,090
All Hours	Exetel	50/20 Mbps	88.4%	9.3%	85.8% - 91.0%	48	9,727
All Hours	iiNet	100/40 Mbps	90.4%	8.2%	88.1% - 92.6%	51	9,307
All Hours	iiNet	50/20 Mbps	86.5%	13.6%	83.3% - 89.6%	71	15,020
All Hours	Optus	100/40 Mbps	89.4%	11.1%	86.2% - 92.6%	47	9,538
All Hours	Optus	50/20 Mbps	91.6%	7.4%	90.0% - 93.3%	81	16,521
All Hours	Telstra	100/40 Mbps	88.1%	12.9%	84.8% - 91.5%	57	11,701
All Hours	Telstra	50/20 Mbps	84.1%	15.8%	81.4% - 86.8%	130	27,708
All Hours	TPG	100/40 Mbps	89.4%	11.0%	86.6% - 92.3%	57	11,134
All Hours	TPG	50/20 Mbps	89.6%	9.4%	87.7% - 91.5%	96	19,175

Period	RSP	Speed Tier	Download Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	100/40 Mbps	89.2%	10.2%	86.7% - 91.6%	66	3,423
All Hours	Aussie Broadband	50/20 Mbps	86.2%	13.3%	82.7% - 89.7%	56	3,281
All Hours	Exetel	50/20 Mbps	87.7%	9.4%	85.0% - 90.3%	48	2,870
All Hours	iiNet	100/40 Mbps	89.4%	8.3%	87.1% - 91.7%	51	2,749
All Hours	iiNet	50/20 Mbps	85.9%	13.6%	82.8% - 89.1%	71	4,507
All Hours	Optus	100/40 Mbps	88.8%	11.1%	85.6% - 92.0%	47	2,795
All Hours	Optus	50/20 Mbps	90.8%	7.7%	89.1% - 92.4%	81	4,815
All Hours	Telstra	100/40 Mbps	86.0%	14.0%	82.4% - 89.7%	57	3,464
All Hours	Telstra	50/20 Mbps	83.2%	15.7%	80.5% - 85.9%	130	8,101
All Hours	TPG	100/40 Mbps	88.5%	10.8%	85.7% - 91.3%	57	3,257
All Hours	TPG	50/20 Mbps	88.7%	9.4%	86.8% - 90.6%	96	5,559

Period	RSP	Speed Tier	Upload Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	100/40 Mbps	88.5%	14.1%	85.1% - 91.9%	66	11,821
All Hours	Aussie Broadband	50/20 Mbps	81.7%	21.1%	76.2% - 87.3%	56	11,071
All Hours	Exetel	50/20 Mbps	90.2%	11.0%	87.1% - 93.3%	48	9,725
All Hours	iiNet	100/40 Mbps	89.8%	12.7%	86.3% - 93.2%	51	9,291
All Hours	iiNet	50/20 Mbps	80.8%	23.8%	75.2% - 86.3%	71	14,923
All Hours	Optus	100/40 Mbps	90.0%	9.1%	87.4% - 92.6%	47	9,491
All Hours	Optus	50/20 Mbps	85.4%	18.0%	81.5% - 89.4%	81	16,452
All Hours	Telstra	100/40 Mbps	88.8%	13.9%	85.2% - 92.4%	57	11,631
All Hours	Telstra	50/20 Mbps	81.7%	22.1%	77.9% - 85.5%	130	27,589
All Hours	TPG	100/40 Mbps	89.5%	10.4%	86.8% - 92.2%	57	11,047
All Hours	TPG	50/20 Mbps	85.9%	18.2%	82.3% - 89.5%	96	19,034

Period	RSP	Speed Tier	Upload Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	100/40 Mbps	88.0%	14.4%	84.5% - 91.4%	66	3,430
All Hours	Aussie Broadband	50/20 Mbps	81.5%	21.1%	76.0% - 87.1%	56	3,277
All Hours	Exetel	50/20 Mbps	89.9%	11.0%	86.8% - 93.0%	48	2,890
All Hours	iiNet	100/40 Mbps	89.3%	12.7%	85.8% - 92.8%	51	2,715
All Hours	iiNet	50/20 Mbps	80.6%	23.7%	75.1% - 86.1%	71	4,460
All Hours	Optus	100/40 Mbps	89.1%	9.4%	86.4% - 91.8%	47	2,782
All Hours	Optus	50/20 Mbps	84.7%	18.5%	80.6% - 88.7%	81	4,784
All Hours	Telstra	100/40 Mbps	88.3%	14.0%	84.7% - 92.0%	57	3,446
All Hours	Telstra	50/20 Mbps	81.6%	22.0%	77.8% - 85.4%	130	8,078
All Hours	TPG	100/40 Mbps	88.5%	10.8%	85.7% - 91.3%	57	3,237
All Hours	TPG	50/20 Mbps	85.6%	18.6%	81.8% - 89.3%	96	5,509

RSP	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Aussie Broadband	0.24	0.50	0.17 - 0.32	173
Dodo & iPrimus	0.40	0.93	0.15 - 0.65	55
Exetel	0.27	0.97	0.06 - 0.48	85
iiNet	0.21	0.38	0.15 - 0.26	162
MyRepublic	0.24	0.46	0.13 - 0.35	61
Optus	0.44	1.01	0.27 - 0.60	144
Telstra	0.28	0.67	0.19 - 0.36	225
TPG	0.31	0.74	0.20 - 0.41	200
Vodafone	0.17	0.41	0.08 - 0.25	87

RSP	Percentage of Outages Lasting 30-60sec	Percentage of Outages Lasting 1-3min	Percentage of Outages Lasting 3-10min	Percentage of Outages Lasting 10min or more
Aussie Broadband	13.3%	38.9%	35.3%	12.5%
Dodo & iPrimus	27.5%	28.0%	35.3%	9.2%
Exetel	45.0%	33.8%	14.9%	6.3%
iiNet	29.7%	42.4%	22.8%	5.1%
MyRepublic	25.0%	30.4%	22.3%	22.3%
Optus	40.1%	38.6%	18.6%	2.7%
Telstra	29.5%	42.8%	22.1%	5.6%
TPG	31.2%	32.6%	27.9%	8.2%
Vodafone	48.0%	22.2%	19.7%	10.1%

Note that, in this report, outage statistics include data collected from volunteers located in Western Australia, whereas download and upload results do not.

NBN speed tier tables

The following tables show statistical information on download and upload speeds for each speed tier, including all tested RSPs.

The overall speed is the average speed (download or upload) for the particular NBN speed tier, measured as a percentage of maximum plan speed.

Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.

The 95% confidence interval is a range in which the 'true' average value is estimated to lie.

- For example: during testing, we measured an average download performance of 89.1% of maximum plan speed for users subscribed to 100/40Mbps NBN fixed-line plan with a 95% confidence interval of ±1.1%. If we were to repeat our sampling 100 times, we expect that this average would fall between 88.0% and 90.1% (rounded to 1 decimal place) in at least 95 cases.

For the 12/1Mbps tier, the sample size is considered low and results are indicative only.

Period	Speed Tier	Download Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	100/40 Mbps	89.1%	10.7%	88.0% - 90.1%	397	76,114
All Hours	50/20 Mbps	87.4%	13.0%	86.3% - 88.4%	596	121,456
All Hours	25/5 Mbps	91.9%	5.5%	90.8% - 93.1%	89	19,632
All Hours	12/1 Mbps	91.8%	1.9%	91.1% - 92.6%	27	5,746

Period	Speed Tier	Download Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	100/40 Mbps	88.0%	10.9%	87.0% - 89.1%	395	22,399
Busy Hours	50/20 Mbps	86.5%	13.0%	85.5% - 87.6%	596	35,649
Busy Hours	25/5 Mbps	91.3%	5.9%	90.1% - 92.5%	89	5,979
Busy Hours	12/1 Mbps	90.8%	2.7%	89.8% - 91.8%	27	1,746

Period	Speed Tier	Upload Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	100/40 Mbps	88.3%	13.5%	87.0% - 89.6%	397	75,751
All Hours	50/20 Mbps	83.6%	20.5%	81.9% - 85.2%	596	120,906
All Hours	25/5 Mbps	92.0%	8.0%	90.4% - 93.7%	89	19,531
All Hours	12/1 Mbps	85.9%	14.0%	80.6% - 91.1%	27	5,745

Period	Speed Tier	Upload Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	100/40 Mbps	87.6%	13.8%	86.2% - 89.0%	395	22,276
Busy Hours	50/20 Mbps	83.3%	20.6%	81.6% - 84.9%	596	35,454
Busy Hours	25/5 Mbps	91.9%	8.1%	90.2% - 93.5%	89	5,921
Busy Hours	12/1 Mbps	85.9%	13.9%	80.6% - 91.1%	27	1,748

NBN technology tables

The following tables show statistical information on download speeds, upload speeds, and outages on a per-technology basis.

The overall speed is the average speed (download or upload) for the technology type, measured as a percentage of the maximum plan speed for each subscriber.

Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.

The 95% confidence interval is a range in which the 'true' average value is estimated to lie.

- For example: during testing, we measured an average download performance of 92.6% of maximum plan speed for fibre to the premises NBN fixed-line connections with a 95% confidence interval of ±0.4%. If we were to repeat our sampling 100 times, we expect that this average would fall between 92.2% and 93.1% (rounded to 1 decimal place) in at least 95 cases.

Period	Technology	Download Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Fibre to the premises - FTTP	92.6%	4.3%	92.2% - 93.1%	318	64,213
All Hours	Fibre to the curb - FTTC	91.6%	5.3%	90.4% - 92.8%	73	14,630
All Hours	Hybrid fibre-co-axial - HFC	92.4%	4.0%	91.9% - 93.0%	208	40,090
All Hours	Fibre to the node - FTTN	84.0%	15.3%	82.7% - 85.3%	516	104,947

Period	Technology	Download Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Fibre to the premises - FTTP	91.7%	4.7%	91.2% - 92.2%	318	19,012
Busy Hours	Fibre to the curb - FTTC	90.7%	5.3%	89.5% - 92.0%	72	4,333
Busy Hours	Hybrid fibre-co-axial - HFC	91.2%	5.4%	90.5% - 92.0%	207	11,688
Busy Hours	Fibre to the node - FTTN	83.2%	15.3%	81.9% - 84.6%	516	31,008

Period	Technology	Upload Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Fibre to the premises - FTTP	93.3%	6.2%	92.6% - 93.9%	318	63,881
All Hours	Fibre to the curb - FTTC	91.7%	9.1%	89.7% - 93.8%	73	14,554
All Hours	Hybrid fibre-coaxial - HFC	90.3%	7.1%	89.3% - 91.2%	208	39,872
All Hours	Fibre to the node - FTTN	79.2%	22.9%	77.2% - 81.2%	516	104,550

Period	Technology	Upload Average % of Maximum Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Fibre to the premises - FTTP	93.0%	6.3%	92.3% - 93.7%	318	18,873
Busy Hours	Fibre to the curb - FTTC	91.5%	9.9%	89.2% - 93.8%	72	4,325
Busy Hours	Hybrid fibre-coaxial - HFC	89.0%	8.7%	87.8% - 90.2%	207	11,630
Busy Hours	Fibre to the node - FTTN	79.0%	22.9%	77.0% - 81.0%	516	30,830

Technology	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Fibre to the premises - FTTP	0.17	0.30	0.14 - 0.20	351
Fibre to the curb - FTTC	0.44	1.16	0.18 - 0.70	78
Hybrid fibre-coaxial - HFC	0.33	0.67	0.24 - 0.42	222
Fibre to the node - FTTN	0.31	0.77	0.24 - 0.37	582

Technology	Percentage of Outages Lasting 30-60sec	Percentage of Outages Lasting 1-3min	Percentage of Outages Lasting 3-10min	Percentage of Outages Lasting 10min or more
Fibre to the curb - FTTC	48.7%	30.3%	14.6%	6.4%
Fibre to the node - FTTN	26.0%	38.5%	28.2%	7.2%
Fibre to the premises - FTTP	31.2%	37.8%	23.9%	7.1%
Hybrid fibre-coaxial - HFC	35.4%	34.3%	21.2%	9.2%

NBN state tables

This table shows statistical information on download speeds on a per-state basis.

The overall speed is the average speed (download or upload) for the technology type, measured as a percentage of the maximum plan speed for each subscriber.

Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.

The 95% confidence interval is a range in which the 'true' average value is estimated to lie.

- For example: during testing, we measured an average download performance of 89.2% of maximum plan speed for NBN fixed-line connections in TAS, with a 95% confidence interval of ±2.6%. If we were to repeat our sampling 100 times, we expect that this average would fall between 86.6% and 91.8% in at least 95 cases.

Period	State/Territory	Download Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	NSW	88.6%	11.8%	87.4% - 89.7%	409	84,947
All Hours	ACT	86.5%	14.1%	82.9% - 90.0%	61	12,053
All Hours	VIC	89.2%	10.7%	88.0% - 90.4%	328	64,406
All Hours	QLD	87.1%	13.5%	85.1% - 89.0%	184	35,108
All Hours	WA	NA	NA	NA - NA	0	0
All Hours	TAS	89.2%	9.7%	86.6% - 91.8%	53	11,258
All Hours	NT + SA	90.2%	8.3%	88.4% - 92.0%	80	16,108

NBN50 and NBN100 Advertised Speed Tables

The figures in the following table are based on the typical evening hour speeds that were advertised by RSPs at the end of the measurement period[*] . The single weighted average speed claim is calculated based on the number of Whiteboxes online for each RSP for each tier (excluding underperforming and impaired services).

RSP	NBN50 Advertised % of Maximum Plan Speed	NBN100 Advertised % of Maximum Plan Speed	Number of NBN50 Whiteboxes (excluding underperforming and impaired services	Number of NBN100 Whiteboxes (excluding underperforming and impaired services	Weighted Advertised % of Maximum Plan Speed
Aussie Broadband	86.0%	86.0%	43	59	86.0%
Dodo & iPrimus	82.0%	82.0%	22	10	82.0%
Exetel	80.0%	77.0%	43	20	79.0%
iiNet	87.0%	80.6%	54	46	84.1%
MyRepublic	86.0%	83.0%	26	27	84.5%
Optus	80.0%	80.0%	71	41	80.0%
Telstra	88.0%	88.0%	97	42	88.0%
TPG	91.2%	85.6%	84	51	89.1%
Vodafone	88.0%	84.0%	31	34	85.9%

Telstra's advertised speed claim of 88 Mbps for its NBN100 plan does not apply to fibre to the node or fibre to the curb services, and so these technologies are excluded from Telstra's counts.

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[*] The claim figures used for Dodo & iPrimus in this report are iPrimus' claim for the period; the two Vocus brands, Dodo and iPrimus, subsequently aligned speed claims at this value.

There were 120 busy hours across the 30 day period from 22nd May 2020 to 20th June 2020. The following table shows the proportion of busy hours in which each RSP's average speed for each tier met the advertised claims above.

RSP	% of busy hours in which advertised download speed met or exceeded	% of busy hours in which advertised download speed met or exceeded (excluding underperforming and impaired services)
Aussie Broadband	77%	100%
Dodo & iPrimus	43%	95%
Exetel	100%	100%
iiNet	59%	100%
MyRepublic	85%	98%
Optus	100%	100%
Telstra	38%	84%
TPG	49%	92%
Vodafone	58%	97%

# NBN Whiteboxes connected to underperforming services

The following table shows the number of Whiteboxes on NBN connections for each RSP, alongside the number of Whiteboxes connected to underperforming services.

RSP	NBN Whiteboxes	NBN Whiteboxes on underperforming services	% NBN Whiteboxes on underperforming services
Aussie Broadband	145	8	6%
Dodo & iPrimus	52	7	13%
Exetel	77	3	4%
iiNet	137	12	9%
MyRepublic	58	4	7%
Optus	134	7	5%
Other RSPs	35	4	11%
Telstra	209	28	13%
TPG	188	10	5%
Vodafone	80	7	9%
Total	1115	90	8%

As highlighted earlier in the report, the majority of underperforming services are connected to fibre to the node infrastructure. The following table shows the number of Whiteboxes on fibre to the node services for each speed tier, alongside the number of underperforming services.

Technology	Speed Tier	NBN Whiteboxes	NBN Whiteboxes on underperforming services	% NBN Whiteboxes on underperforming services
Fibre to the node - FTTN	12/1 Mbps	12	0	0%
Fibre to the node - FTTN	25/5 Mbps	63	1	2%
Fibre to the node - FTTN	50/20 Mbps	334	64	19%
Fibre to the node - FTTN	100/40 Mbps	107	22	21%
Fibre to the node - FTTN	All NBN Speed Tiers	516	87	17%

How we test
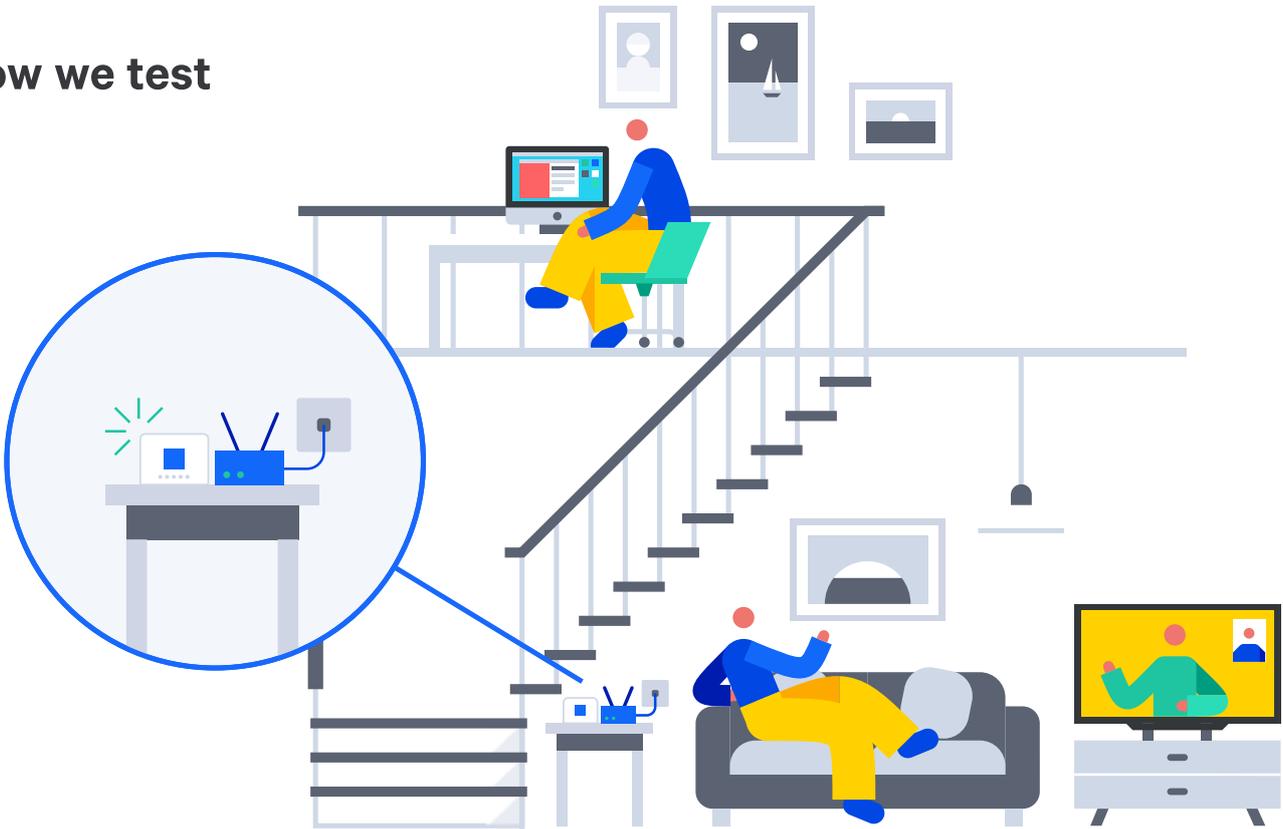
Measuring from homes across Australia

- The SamKnows Whitebox is a purpose-built testing agent that connects to your router.

- Measures every aspect of your internet service delivered to your home.

- Runs at regular intervals when you're not using the internet.
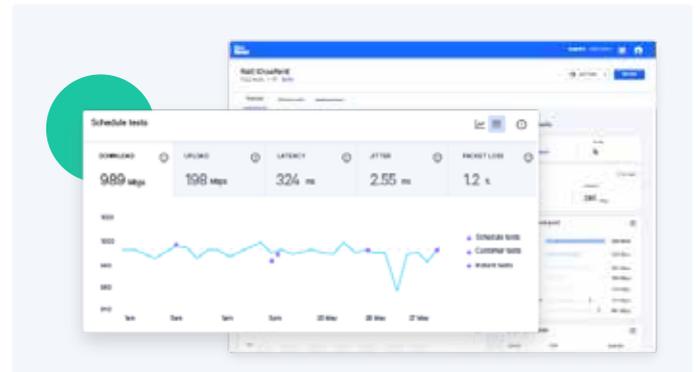
SamKnows One analytics

- View all your data in one place.

- Create customised charts and save the results that mean the most to you.

- Track changes in your connection over time.

Sign up

Please participate by volunteering to receive a Whitebox. The more volunteers we have, the more information we can provide to consumers in Australia in future reports: https://measuringbroadbandaustralia.com.au/signup

Our Tests

Metric		Definition
	Download	The speed data travels from our test server to your device, measured in bits per second.
	Upload	The speed data travels from your device to our test server, measured in bits per second.
	Latency	How long it takes a data packet to go from your device to our test server and back to your device.
	Jitter	Measures the amount of difference between packet delays, or the stability of your latency.
	Packet Loss	When a packet of data becomes lost (does not arrive for two seconds) measured as a percentage of packets lost out of packets sent.
	Video Conferencing	Measures round-trip latency and reachability of a selection of video conferencing services.
	Video streaming	Measures the highest bitrate you can reliably stream for the most popular video in your country.
	Web browsing	Measures how long it takes to fetch the HTML and referenced resources of a popular website.
	CDN Measurements	Measures download performance for the same (or very similar) object from a variety of popular Content Delivery Networks over HTTP.
	Voice over IP	Measures the suitability of a broadband connection for VoIP calls.